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CLINICAL INVESTIGATION

Endovenous Laser Ablation as a Treatment for Postsurgical Recurrent Saphenous Insufficiency

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Abstract The purpose of this study was to investigate the safety and efficacy of endovenous laser ablation as a treatment for recurrent symptomatic saphenous insufficiency occurring after saphenous vein ligation and stripping. A single-center retrospective review of patients who received endovenous laser ablation as a treatment for recurrent symptomatic saphenous insufficiency after ligation and stripping between November 2003 and October 2006 was performed. Fifty-six insufficient saphenous systems were identified in 38 patients. Follow-up consisted of a clinical examination in all patients as well as selective lower-extremity duplex ultrasound as clinically indicated. All 38 patients demonstrated complete closure of the insufficient saphenous vein by clinical examination and/or duplex ultrasound evaluation. Preoperative symptoms resolved after treatment in all 38 patients. No major complications were identified. Endovenous laser ablation of recurrent symptomatic saphenous venous insufficiency is a safe and effective treatment in patients who develop recurrent symptoms after saphenous vein ligation and stripping.

Keywords Interventional radiology · Laser vein ablation · Recurrence

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Introduction

Varicose veins (VVs) are estimated to affect 25% of women and 15% of men, and they can occur alone or in association with chronic venous insufficiency [1]. The venous system in the legs consists of the superficial, perforating, and deep venous systems. VVs are palpable, visible, tortuous, and dilated superficial veins. The pathophysiology of VV formation remains poorly understood. Although the etiology is likely multifactorial, heredity seems to play a large role in its pathogenesis [2]. Other commonly cited culprits are female hormonal influence, pregnancy, prolonged standing or sitting, and trauma [2]. VVs in the leg primarily arise from the superficial venous system, which is comprised of the small saphenous vein (running along the posterior calf), the great saphenous vein (GSV; running along the medial thigh and calf), and their branches. While many view VVs as a cosmetic issue, many of those afflicted note significant symptoms. In addition, 30% of patients with symptomatic VVs have deep vein incompetence, and 50% have perforator vein incompetence, indicating that VVs could be a harbinger of more serious issues [3].

Multiple therapeutic options exist for patients with superficial venous insufficiency. Conservative first-line treatment may involve the use of custom-fit thigh-high graduated compression stockings. Although compression stockings decrease venous pressure, venous reflux, and residual venous volume, their effect is lost on removal [4]. More aggressive therapeutic options include surgical ligation and stripping and, more recently, endovenous laser or radiofrequency ablation. Ligation and stripping of the GSV has been shown to have an extremely high degree of recurrence [5–8], estimated to be as high as 51% at 5 years [9] and as high as 62% at 11 years [10]. Fisher et al.

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followed a cohort of patients that underwent ligation and stripping during the course of 34 years and showed a recurrence rate of 60%, with more than one third of patients requiring additional treatment [5]. Left untreated, nearly 50% of patients with recurrent venous insufficiency will eventually experience signs and symptoms of progressive chronic venous insufficiency [11]. Patients with recurrent saphenous insufficiency occurring after surgical correction appear to have an especially aggressive clinical course compared with patients having untreated legs [12].

The approach to treating patients with recurrent VVs after ligation and stripping has traditionally been reoperation. In fact, it has been estimated that >20% of VV operations each year are for recurrent disease [13]. Reoperation is a more technically demanding procedure than the primary surgery and can fail in up to 35% to 80% of cases [8, 12, 13]. Ligation and stripping is performed with the patient under general anesthesia. The recovery period can be long and frequently leads to patients taking between 1 to 3 weeks off from work [14]. A desirable alternative to ligation and stripping would be a treatment that is less technically complex, has a lower rate of recurrence, and has a shorter recovery time.

Endovenous laser vein ablation (EVLA) is an increasingly common treatment modality for superficial venous insufficiency. EVLA, first approved by the Food and Drug Administration in 2002, uses a laser heat source to deliver thermal energy into the blood vessel lumen. This focused energy produces targeted destruction of the endothelial and venous walls, leading to fibrosis and ultimately vessel occlusion when combined with adequate compressive therapy after the procedure. Because this treatment has been successfully used as an alternative to surgery for primary saphenous system insufficiency [15, 16], we postulated that it may also be beneficial in patients who develop recurrent superficial venous reflux after surgical treatment. This study was initiated to assess the safety and efficacy of EVLA as a treatment for recurrent saphenous insufficiency after surgical ligation and stripping.

Materials and Methods

Patient Selection

This is a single-center retrospective review of patients who received EVLA as a treatment of recurrent symptomatic saphenous insufficiency after ligation and stripping between November 2003 and October 2006. Patients with recurrent GSV or branch vessel insufficiency were given the choice of reoperation with ligation and stripping or EVLA. EVLA was not advised for patients with extremely tortuous recurrence pathways because of the difficulty in endovenous passage of the laser fiber, for patients who had very superficial target veins, or for patients who were pregnant or who had plans to become pregnant during the course of treatment. Fifty-six consecutive saphenous veins among 38 patients with previous ligation and stripping were treated with a 980-nm endovenous laser between November 2003 and October 2006 and were included in the study. This study was approved by the Northwestern University Medical School Institutional Review Board.

Demographic data as well as procedural outcomes were examined. Thirty-one of the thirty-eight patients (82%) were female, and 7 (18%) were male. The study population ranged in age from 32 to 78 years old (mean). These demographic data were similar to those of our overall clinic patient population.

Procedure and Follow-Up Care

A detailed history was taken from each patient to document the date of previous surgery, years of symptoms, and whether any treatments, such as reoperation or adjunctive therapy, had been previously attempted. A physician experienced in venous disease evaluation conducted a clinical examination to identify the features of chronic venous insufficiency, the stage of venous disease, and the presence of systemic disease. Patients were then examined with both upright and supine duplex ultrasound to identify and map the pattern of venous incompetence.

On the day of therapy, 0.5 mg alprazolam was given 30 min before the procedure, with an additional dose at the time of procedure if needed as determined by the treating physician. The lower extremity to be treated was prepped and draped in sterile fashion. Mapping of the incompetent saphenous vein with the patient in the recumbent position was performed, and this pathway was marked cutaneously. A percutaneous point of entry into the vein was chosen at the caudal margin of venous abnormality.

After raising a small skin wheel with 1% lidocaine, the saphenous vein in question was punctured under sonographic guidance using a 21-gauge needle. A 0.018-inch diameter initial access wire from the micropuncture access set (Cook Medical, Bloomington, IN) was passed through this needle. Exchange was then made for a 0.038-inch diameter J-tip guidewire (VenaCure Kit; AngioDynamics, Queensbury, NY), which was advanced into the vein under sonographic visualization until its tip lay at the cephalad most extent of the insufficient vein. In most cases, this resulted in the wire being advanced up to an area of previous ligation, just below the expected location of the saphenofemoral junction (SFJ). In some instances, a contiguous course through the SFJ was present, and in those cases the guidewire was advanced into the common femoral vein. A 4F introducer sheath was advanced over the J-

tip guidewire. The guidewire and sheath introducer were then removed, and the 65-cm optical laser fiber was passed through the sheath.

The laser fiber was advanced under sonographic guidance until its tip lay at the terminus of the sheath. The fiber was then exposed by withdrawal of the sheath and Luer locking of the fiber to the sheath back-end valve (VenaCure Kit). The proper position was confirmed sonographically with supporting visual observation of transillumination from the aiming beam through the skin. Once the laser fiber was satisfactorily positioned, tumescent anesthetic was infused under ultrasound guidance around the saphenous vein through the same 21-gauge needle used for initial venous entry using a Klein peristaltic infiltration pump set to 3 to 4 cc/s. The tumescent anesthetic solution mixture consisted of 450 cc normal saline, 50 cc 1% lidocaine with or without 1:100,000 epinephrine at the primary operator's discretion, and 5 mEq sodium bicarbonate. A variable volume of tumescent was used for each ablative procedure at the physician operator's discretion.

The laser fiber was connected to a 980-nm diode Precision 980 Laser (Angiodynamics). Laser energy was delivered along the vein at 14 W in continuous mode. The fiber and introducing catheter were slowly withdrawn in unison at an average rate of 3 to 6 s/cm until a distance of 1 to 2 cm to the access site was reached. The laser fiber and catheter were then removed, and manual compression was applied for hemostasis. As deemed indicated by the primary operator, a number of these patients also underwent a microphlebectomy procedure for removal of the visible surface varicosities. This procedure was performed either in the same setting or in a staged fashion.

After the procedure, class II (30 to 40 mmHg) graduated thigh-high compression stockings were worn for 3 weeks; continuously for the first week and then only during waking hours for the remaining 2 weeks. Patients were instructed to resume their normal activities right away with the exception of lifting >15 to 20 lb during the first 2 weeks after the procedure. Naproxen was given at a dose of 500 mg orally twice daily for 2 weeks and was the only postoperative medication administered. Patients were instructed to return 1 week after the procedure for suture removal, clinical examination, and possible duplex ultrasound as clinically indicated. They were then scheduled for a second follow-up visit after an additional 4 to 6 weeks. At this second visit, all patients underwent clinical examination of the treated area, and some received duplex ultrasound as clinically indicated.

Results

Remnant GSV was responsible for 43 of the 56 cases (77%) of recurrent venous insufficiency after ligation and stripping (Table 1). The remainder consisted of either duplicate GSV or frequently encountered branches of the saphenous system (Table 1). Remnant saphenous vein ablation was technically successful in 56 of 56 (100%) patients as confirmed by clinical evaluation and/or duplex ultrasound. EVLA also resulted in improvement or resolution of patient symptoms in all 56 cases. Bruising was a common but transient complication of EVLA and usually resolved within 1 to 2 weeks after surgery.

Table 1 Characteristics of remnant vein(s)

Remnant vein(s) ablated	No.	%
Great saphenous	43	77
Posteromedial branch	4	7
Duplicate great saphenous	4	7
Anterolateral branch	3	5
Small saphenous	2	4

Discussion

EVLA is an increasingly common treatment modality for superficial venous system insufficiency. Although this treatment has been successfully used as an alternative to surgery for primary saphenous system insufficiency [15, 16], it has not been well described as a treatment for postsurgical recurrence of superficial venous insufficiency.

Surgical ligation and stripping of the GSV has a high rate of recurrent venous insufficiency, with more than one third of these patients requiring additional treatment [5–8]. This may be due to incomplete surgical removal of the GSV, which can enlarge with time [17, 18]. A residual GSV can occur because the original operator may have failed to do a true SFJ ligation [19], incorrectly identified the SFJ [20], or left the GSV intact altogether [21–23]. Duplication of the GSV by a large anterolateral or posteromedial tributary that rejoins the GSV near the knee has been reported as being present in up to 49% of limbs, with 88% of duplications being present in the thigh [24–26]. Furthermore, failure to recognize the large variation in SFJ tributary patterns may lead the surgeon to erroneously believe that he or she has adequately ligated all tributaries [23, 27]. Although this may account for a portion of the recurrence rate, persistent venous insufficiency has occurred even when ligation and stripping had been described as complete and adequate [9, 28].

Neovascularization, first proposed by Glass et al., may account for recurrence of venous insufficiency even when adequate ligation and stripping has been performed [29]. In this situation, the mechanism of recurrence is by way of

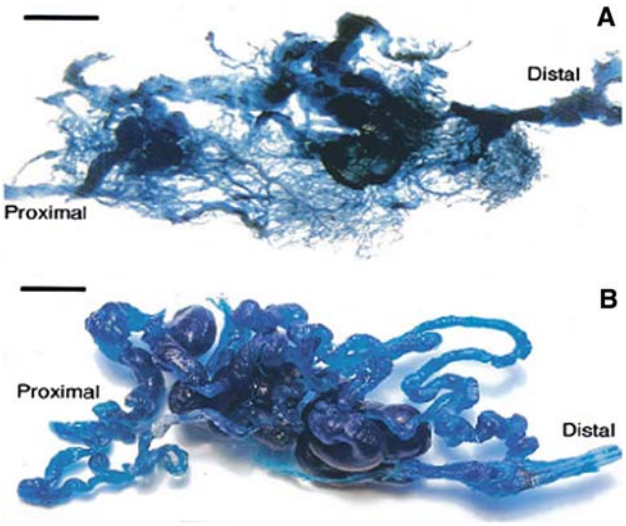

Fig. 1 Casts obtained after injecting resin into surgically resected refluxing saphenofemoral venous specimens. Both patients are status post–previous ligation and stripping with recurrent VVs. These resin casts depict the tortuous and extensive neovascular venovenous web that reconnects the superficial and deep venous systems at the site of previous ligation in the groin. Reprinted with permission

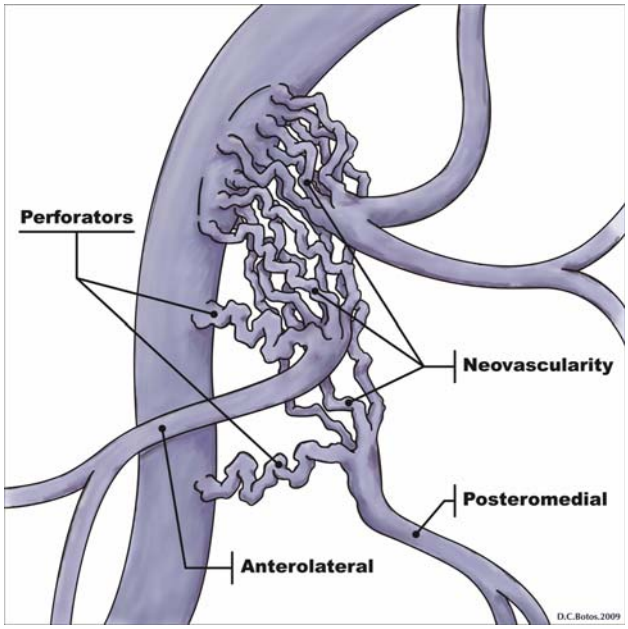

Fig. 2 Illustration depicting neovascular channels that reconnect the superficial and deep venous systems

venovenous reconnection [29]. New vessel growth from the SFJ dissection and ligation-induced inflammatory reaction is recognized in as many as 94% of patients with recurrent VVs [30], and has been identified by some investigators as the most common cause of recurrent VVs after surgery [9, 10, 28, 31–35]. This has been clearly demonstrated on phlebography [33], duplex ultrasonography [30, 35], histology [30, 34], surgical dissection [36], and resin casting [30]. Fig. 1 shows resin casting of two patients with postsurgical recurrent venous insufficiency [37]. The tortuous nature of these vessels is typical of neovascular changes [30]. Neovascularization has been shown to increase with time after surgery [10]. Postoperative angiogenesis may lead to reconnection between the deep and superficial venous systems by way of a residual GSV segment, a duplicate GSV, or a major saphenous tributary, such as the anterolateral or posteromedial vein [35, 38]. This reconnection between the deep and superficial venous systems is depicted in Fig. 2.

Regardless of the reason why primary correction of VVs with ligation and stripping was inadequate, recurrent venous insufficiency can be treated safely and effectively by EVLA. In our study, all 56 GSVs treated with EVLA remained closed with no evidence of recanalization by either clinical examination and/or duplex ultrasonography. EVLA was safe, with bruising being the most common complication. Bruising was usually mild to moderate and resolved within 1 to 2 weeks. No major complications were identified. These results are similar to those seen in primary treatment of GSV insufficiency using EVLA [39].

Although our study shows the effectiveness of EVLA in treating recurrent VVs, studies with longer follow-up are needed to explore the recurrence of venous insufficiency after the use of EVLA for postsurgical venous insufficiency. This issue is particularly relevant given that the causative neovascular network is not directly treated with ELVA therapy. However, steam generated during ablation of the incompetent saphenous vein is frequently identified entering the neovascular network using control sonography performed during the ablative portion of the procedure. These super-heated steam bubbles have been described as a mechanism of collagen contraction and endothelial injury, ultimately leading to venous fibrosis and occlusion [16]. It is possible that this thermal insult may result in complete or partial ablation of the venous collateral network in question. This collateral effect is not seen in repeat surgical ligation and stripping. Although not performed in our study, one can also postulate a potential benefit from intentionally ablating the neovascular network with a foamed sclerosant before thermal ablation of the saphenous vessel in question.

Although this study is retrospective, and thus has its limitations, we are encouraged by our results. EVLA has been shown to be beneficial in the treatment of primary GSV incompetence. Our study suggests there may also be a role for EVLA in the treatment of recurrent saphenous system insufficiency after previous ligation and stripping. Endovenous ablation using a 980-nm diode appears to be a safe, well-tolerated, and effective in-office procedure for patients experiencing postsurgical recurrent saphenous

system reflux brought on by residual GSV or tributary incompetence. This procedure appears to offer an excellent alternative to traditional reoperation and may offer the addition benefit of collateral ablation of the causative neovascular collateral network. Further studies exploring the frequency of recurrence of saphenous insufficiency and recanalization after the use of EVLA for postsurgical venous insufficiency are needed as are studies with long-term follow up after EVLA.

References

1. Callam MJ (1994) Epidemiology of varicose veins. Br J Surg 81:167–173
2. Gloviczki P, Yao JST (eds) (2001) Handbook of venous disorders: guidelines of the American Venous Forum. Chapman & Hall Medical, London, UK
3. Katsamouris AN, Kardoulas DG, Gourtsoyiannis N (1994) The nature of lower extremity venous insufficiency in patients with primary varicose veins. Eur J Vasc Surg 8:464–471
4. Labropoulos N, Leon M, Volteas N, Nicolaides AN (1994) Acute and long-term effect of elastic stockings in patients with varicose veins. Int Angiol 13:119–123
5. Fischer R, Linde N, Duff C, Jeanneret C, Chandler JG, Seeber P (2001) Late recurrent saphenofemoral junction reflux after ligation and stripping of the greater saphenous vein. J Vasc Surg 34:236–240
6. Rivlin S (1996) Recurrent varicose veins. Med J Aust 1:1097–1102
7. Bradbury AW, Stonebridge PA, Ruckley CV, Beggs I (1993) Recurrent varicose veins: correlation between preoperative clinical and hand-held Doppler ultrasonographic examination and anatomical findings at surgery. Br J Surg 80:849–851
8. Juhan C, Haupert S, Miltgen G (1990) Recurrent varicose veins. Phlebology 5:201–211
9. van Rij AM, Jiang P, Solomon C, Christie RA, Hill GB (2003) Recurrence after varicose vein surgery: a prospective long-term clinical study with duplex ultrasound scanning and air plethysmography. J Vasc Surg 38:935–943
10. Winterborn R, Foy C, Earnshaw J (2004) Causes of varicose vein recurrence: late results of a randomized controlled trial of stripping the long saphenous vein. J Vasc Surg 40:634–639
11. Widmer LK, Mall TH, Martin H (1974) Epidemiology and social medical importance of diseases of the veins. Munch Med Wochenschr 116:1421–1426
12. Perrin RM, Guex JJ, Rukley V, de Palma R, Royle JP, Eklof B, et al. Recurrent varices after surgery (2000): a consensus document. Cardiovasc Surg 8:233-245
13. Negus D (1993) Recurrent varicose veins: a national problem. Br J Surg 80:823–824
14. Kurz X, Kahn SR, Abenhaim L, Clement D, Norgren L, Baccaglini U et al (1999) Chronic venous disorders of the leg: epidemiology, outcomes, diagnosis and management. Int Angiol 18:83–102
15. Lehr H, Kargle A (2002) Endovenous treatment of the greater saphenous vein with a 940-nm diode laser: thrombolytic occlusion after endoluminal thermal damage by laser-generated steam bubbles. J Vasc Surg 35:729–736
16. Min R, Khilnani N, Zimmet S (2003) Endovenous laser treatment of saphenous vein reflux: long-term results. J Vasc Interv Radiol 14:991–996
17. Lees T, Singh S, Beard J, Spencer P, Rigby C (1997) Prospective audit of surgery for varicose veins. Br J Surg 84:44–46
18. Turton EP, Scott DJ, Richards SP, Weston MJ, Berridge DC, Kent PJ et al (1999) Duplex-derived evidence of reflux after varicose vein surgery: neoreflux or neovascularization? Eur J Vasc Endovasc Surg 17:230–233
19. Garner JP, Heppell PSJ, Leopold PW (2003) The lateral accessory saphenous veiñA common cause of recurrent varicose veins. Ann R Coll Surg Engl 85:389–392
20. Stücker M, Netz K, Breuckmann F, Altmeyer P, Mumme A (2004) Histomorphologic classification of recurrent saphenofemoral reflux. J Vasc Surg 39:816–822
21. Sarin S, Scurr JH, Coleridge Smith PD (1992) Assessment of stripping the long saphenous vein in the treatment of primary varicose veins. Br J Surg 79:889–893
22. Blomgren L, Johansson G, Dahlberg-Akerman A, Noren A, Brundin C, Nordstrom E, et al (2004) Recurrent varicose veins: incidence, risk factors and groin anatomy. Eur J Vasc Endovasc Surg 27:269–274
23. Mozes G, Gloviczki P, Kadar A, Dzsinich M (1999) Venous anatomy of the lower limb. In: Ballard JL, Began JJ (eds) Chronic venous insufficiency. Springer-Verlag, London, England, p 28
24. Corrales NE, Irvine A, McGuinness CL, Dourado R, Burnand KG (2002) Incidence and pattern of long saphenous vein duplication and its possible implications for recurrence after varicose vein surgery. Br J Surg 89:323–326
25. Shah DM, Chang BB, Leopold PW, Corson JD, Leather RP, Karmody AM (1996) The anatomy of the greater saphenous system. J Vasc Surg 3:273–283
26. Kupinski AM, Evans SM, Khan AM, Zorn TJ, Darling RC, Chang BB et al (1993) Ultrasonic characterization of the sapehnous vein. Ka Cardiovasc Surg 1:513–517
27. Chun MH, Han SH, Chung JW et al (1992) Anatomical observation on draining patterns of saphenous tributaries in Korean adults. J Korean Med Sci 7:25–33
28. Frings T, Tran VTP, Nelle A, Glowacki P (1999) Recurrence of great saphenous vein varices despite correct ligation of the saphenofemoral junction: neoangiogenesis. Phlebologie 28:144–148
29. Glass GM (1987) Neovascularization in recurrence of the varicose great saphenous vein following transaction. Phlebology 2:81–91
30. van Rij AM, Jones GT, Hill G, Jiang P (2004) Neovascularization and recurrent varicose veins: more histologic and ultrasound evidence. J Vasc Surg 40:296–302
31. Fischer R, Chandler JG, De Maeseneer MG, Frings N, Lefebvre-Vilarbedo M, Earnshaw JJ et al (2002) The unresolved problem of recurrent saphenofemoral reflux. J Am Coll Surg 195:80–94
32. Jones GT, van Rij AM, Jiang P, Christie RA, Thomson IA (2000) Recurrent varicose veins, more evidence for neovascularisation: a comparison of ultrasound and immunohistochemistry. Int Angiol 19(Suppl 1):127
33. Glass GM (1988) Neovascular reconnection in recurrence of varices of the great saphenous vein in the groin: phlebography. Angiology 39:577–582
34. Nyamekye I, Shephard NA, Davies B, Heather BP, Earnshaw JJ (1998) Clinocopathological evidence that neovascularisation is a cause of recurrent varicose veins. Eur J Vasc Endovasc Surg 15:412–415
35. Jones L, Braithwaite BD, Selwyn D, Cooke S, Earnshaw JJ (1996) Neovascularization is the principal cause of varicose vein recurrence: results of a randomized trial of stripping the long saphenous vein. Euro J Vasc Endovasc Surg 12:442–445
36. Geier B, Olbrich S, Barbera L, Stücker M, Mumme A (2005) Validity of the macroscopic identification of neovascularization at the saphenofemoral junction by the operating surgeon. J Vasc Surg 41:64–68

37. van Rij AM, Jones GT, Hill G, Jiang P (2004) Neovascularization and recurrent varicose veins: more histologic and ultrasound evidence. J Vasc Surg 40:296–302 (Reprinted with permission)
38. Dwerryhouse S, Davies B, Harradine K, Earnshaw J (1999) Stripping the long saphenous vein reduces the rate of reoperation for recurrent varicose veins: five-year results of a randomized trial. J Vasc Surg 29:589–592
39. Stirling M, Shortell CK (2006) Endovascular treatment of varicose veins. Semin Vasc Surg 19:109–115